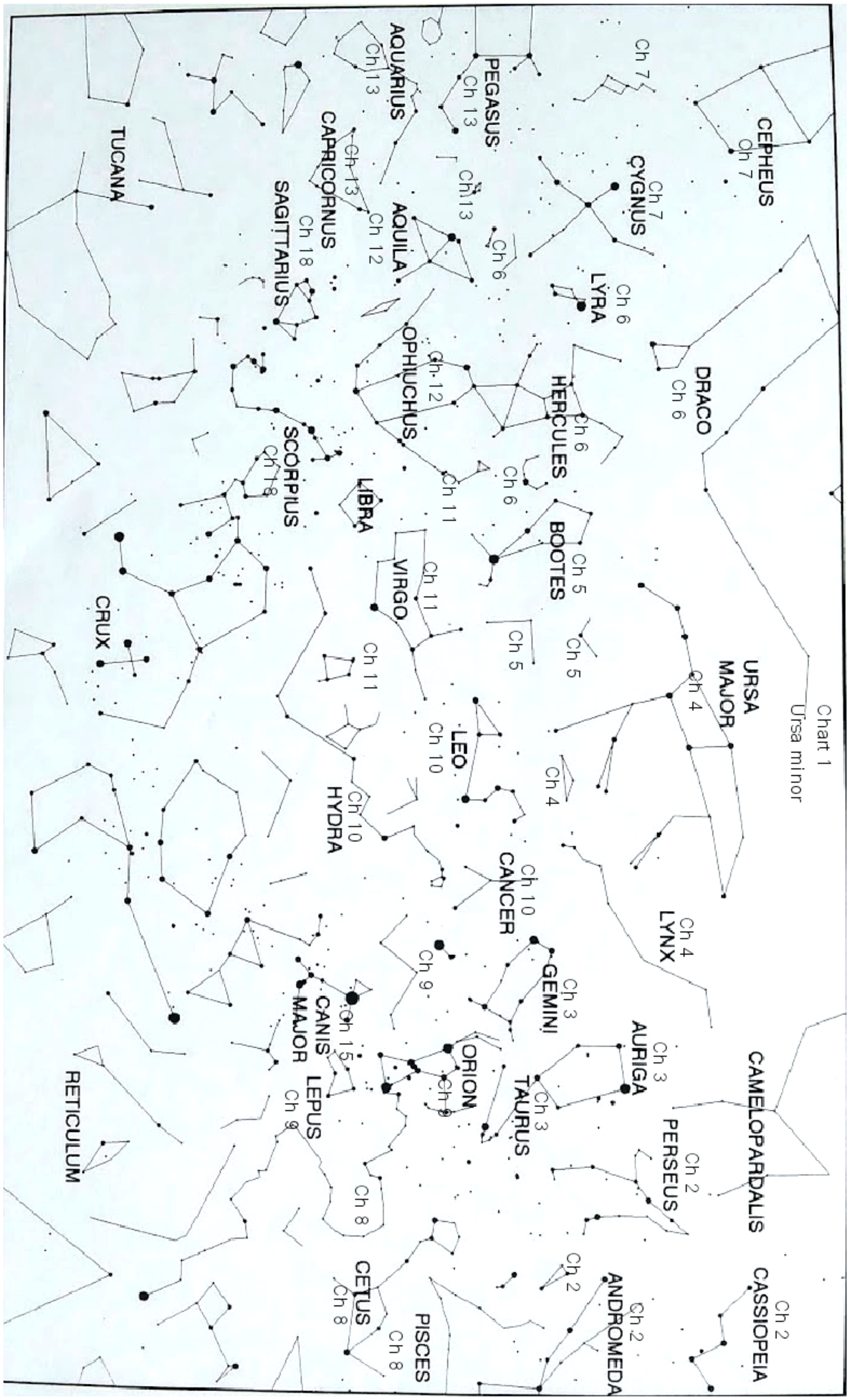

Observing Notes by Jeffrey Hoeper for the *Mag 7 Star Atlas* by Andrew L. Johnson
As updated and enhanced by Mark Hoecker

This booklet is intended for use in the Northern Hemisphere with the *Mag 7 Star Atlas* by Andrew L. Johnson. I recommend printing the notes on the backs of the relevant sky maps in the Atlas. (Jeffrey D. Hoeper)

Useful Sources of Info

https://naasbeginners.co.uk/Whats_up/2020_2021/January2021.htm
https://in-the-sky.org/charts.php, https://freestarcharts.com/
https://www.universetoday.com/19516/constellations/
https://theskylive.com/sky/constellations/
https://www.glyphweb.com/esky/constellations/
https://www.constellation-guide.com/constellation-list/
https://www.messier-objects.com/, https://www.astronomytrek.com/
https://observing.skyhound.com/archives.html
http://stars.astro.illinois.edu/sow/sowlist.html
https://sites.uni.edu/morgans/astro/index.html

Abbreviations

mag=magnitude, sep=separation, OC=open cluster, GC=globular cluster, PN=planetary nebula, DN=diffuse nebula, SG=spiral galaxy, EG=elliptical galaxy, LG=lenticular galaxy, IG=irregular galaxy, var=variable, ly=light years, 10^6=million, 10^9=billion, M⊙=solar masses, D⊙=solar diameters, R⊙=solar radii, FOV field of view, ✨=link to astropic by Brendan Kinch or Jim Mazur or Antoine and Dalia Grelin

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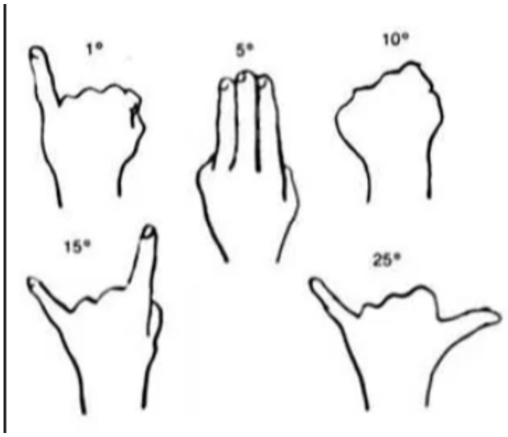
Stellar Classification System

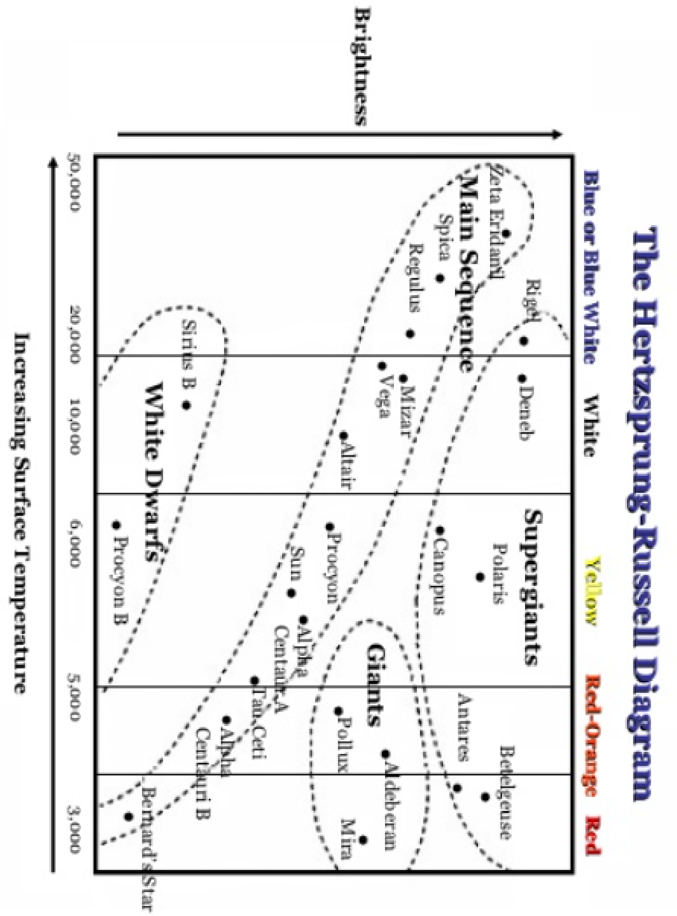
Oh Be A Fine Girl (or Guy), Kiss Me

The colors and temperature ranges are as follows:

O – greater than 30k °K – blue
B – 10k to 30k °K – blue white
A – 7,500 to 10k °K – white
F – 6k to 7,500 °K – yellow white
G – 5,200 to 6k °K – yellow
K – 3,700 to 5,200 °K – orange
M – 2,400 to 3,700 °K – red
(The Sun is G-class)

Measuring the sky with your hand





Ursa Minor (Chart 1) The stars of the Little Dipper, ranging from mag 2 - mag 5, test the clarity of your night sky. The stars in the handle are each separated by 4°. ✨
Alpha α Polaris F-Class Supergiant, mag 2, 445 ly. Dbl sep 18" to mag 9 Polaris B. Polaris A is itself a close binary with the two components orbiting in about 30 years. Polaris A is a Cepheid variable star, the closest to Earth. Polaris A has been closely studied and seems to have less mass than predicted by Cepheid modelling, but there continues to be dispute about its distance, with some methods placing it as close as 326 ly and others as far as 522 ly. It is very unusual. ✨
Beta β Kochab K-class Giant, mag 2.1, 126 ly. It was the pole star 3000 years ago.
Gamma *γ* Pherkad A-class Bright Giant, mag 3.1, 480 ly. Naked-eye dbl with mag 5.
Delta *δ* Yildun A-class, mag 4.4, 183 ly
Epsilon ε G-class Giant, mag 4.2, 345 ly
Zeta *ζ* A-class, mag 4.3, 375 ly
Eta η F-class, mag 5.0, 97 ly. Naked-eye dbl with mag 5.
Theta ϑ K-class Giant, mag 5.0, 832 ly.

Cassiopeia (Chart 2) In 1572 Tycho Brahe (and others) observed a “new star” in the sky near Kappa Cassiopeia. Tycho’s book on this phenomenon shook up the entire world of astronomy by proving that the stars are not fixed and constant.

Alpha α Schedar, K-class Hypergiant, mag 2, 230 ly. Dbl sep 64” to mag 9.

Beta β Caph, F-class Giant, 54 ly. Delta Scuti var, mag 2.25 - 2.31 in 2.5 hours.

Gamma γ, B-class Hypergiant, mag 3, 610 ly. Dbl sep 2.3” to mag 9. Gamma was nicknamed “Navi” by Gus Grissom because of its usefulness in navigating. It rotates so fast (<2 days) that it is ovalized and casts off mass, causing random variations in brightness.

Delta δ Ruchbah A-class Giant, mag 3, 99 ly. Dbl sep 2’ to mag 11.

Eta η Achird, F-class, mag 3, 19 ly. Dbl sep 12” to mag 7 K-class dwarf. ✨

Epsilon ε Segin B-class Giant, mag 3, 442 ly.

M52 OC, mag 6, 9’x9’ (compare Pleiades), 200 stars. ~5000 ly. 35x10^6 years old. ~5° NW of Beta Cas.

NGC457, the Owl Cluster (or ET cluster or Dragonfly Cluster) OC, mag 6, 150 stars, pale haze around 5th and 7th mag eyes of stick figure, 9000 ly. ~6° ENW of Alpha.

M103 OC, mag 7, faint, 40 stars, 8000 ly. Three 7 - 8 mag stars in a row. ~1° E of Delta.

NGC7789, Caroline’s Rose OC, mag 7. Named for its discoverer Caroline Herschel (1783). Faint haze in binocs. Most OC’s are young stars, but these are almost a billion years old. Mostly red giants. ~3° SW of Beta.

NGC281 (Pacman Nebula) DN mag 7, 30’x20’, 9200 ly. H(II) ionized region. ~2° E of Alpha. ✨

NGC7635 (Bubble Nebula) DN mag 11, 15’x8’, 9000 ly. H(II) ionized region. Great for astropics. Near M52. ✨

NGC129, NGC654, NGC7789, NGC1027, NGC225, NGC663, NGC659, NGC637, NGC7790, NGC189, NGC436 OC’s mag 6 - 9.

Andromeda (Chart 2)

Alpha α Alpheratz or Sirrah B-class Sub-giant, mag 2, 97 ly. Rare heavy-metal star. Perhaps 10^4 times as much mercury as Sun, much more gallium, europium too.

Gamma γ Almach K-class giant, mag 2, 355 ly. Dbl sep 10’ to mag 5. Both components are close binaries. ✨

Pi π B-class, mag 4, 659 ly. Dbl sep 35” to mag 9. Both stars are close binaries.

M31 SG mag 3, 178’x70’, 2.5 million ly. Became a Grand Design Spiral Galaxy through the collision of two galaxies about 8 billion years ago. 3 billion years ago it had an encounter with M33. Most of the galactic disk rotates in one direction, but a small region toward the core rotates in the opposite direction as a result of another galactic encounter about 100 million years ago. The inner nucleus has two centers P1 and P2 separated by 5 ly. P2 contains a supermassive black hole of about 140x10^6 M$_\odot$. (Sgr A* is about 4x10^6 M$_\odot$.) So far, 35 black holes have been detected in M31. It contains more than 1x10^12 stars. ✨

M32 EG, mag 8, 8’x5’, contains a supermassive black hole of ~3x10^6 M$_\odot$. No dust clouds or star formation. Mostly old red and yellow stars. 2.6x10^6 ly.

M110 mag 8, 16’x10’, a dwarf spheroidal galaxy of about 10x10^9 stars and 8 globular clusters, 2.7x10^6 ly. Star formation going on. ✨u

NGC7662 (Blue Snowball) PN, mag 8. ~3° SW of Kappa.

NGC7686, NGC752, NGC956 OC’s mag 5.6 - 9

NGC891 SG mag 10, 13’x3’. ~3° E of Gamma.✨

Triangulum (Chart 2)

Gamma γ A-class, mag 4, 118 ly, rotates on axis 2x/day (Sun rotates in 25 days).

Delta δ G-class, binary, mag 5, 35 ly. Sun-like star, but in a binary system which would cause double sunrise\sunset for any Earth-like planet.

M33 SG mag 5.7, 62’x37’, 40x10^9 stars, 2.6x10^6 ly. ✨

Perseus (Chart 2, 3)

Alpha α Mirfak F-class Supergiant, mag 2, 181 ly. Dbl sep 3’ to mag 12 companion.

Beta β Algol B-class, 93 ly, var eclipsing binary, mag 2.1 - 3.4 in 2.867 days, called "the ghoul" or head of Medusa. Beta strips mass from its partner causing surges in brightness. Its variability was first measured by John Goodricke in 1783. Compare the brightness of Beta Cas 2.3, Delta Cas 2.7, Epsilon Persei 2.9, Delta Persei 3.0, and Kappa Persei 3.8. Algol is also a wide double with a mag 10 companion, sep 82”.

Zeta ζ B-class Supergiant, mag 3, 982 ly. Dbl sep 13” to mag 9.

Epsilon ε B-class Hypergiant, mag 3, 538 ly. Dbl sep 9” to mag 8.

Gamma γ G-class Giant, mag 3, 256 ly. Dbl sep 57” to mag 9.

Delta δ B-class Giant, mag 3, 528 ly. Dbl sep 99” to mag 10.

Rho ρ M-class Giant, var 3.3 - 4.0, irregular ~40 days.

Eta η Miram, K-class Supergiant, mag 4, 1331 ly. Dbl sep 28” to mag 8.5. Pretty group of stars in binocs.

Omicron ο B-class Giant, 1475 ly. Dbl sep 1” to mag 7.

Double Cluster -- NGC869, 7200 ly. **NGC884**, 7500 ly. Mag 4. Mostly supergiants like Rigel & Mirfak. ✨

M34 OC mag 6, 20+ stars in binocs, 1400 ly. Young stars (200x10^6 years) but some of them are white dwarfs. ~7° WNW of Algol.

NGC884, NGC1545, NGC1528, NGC1444, NGC1342, NGC1245, NGC1513 OC’s mag 4 - 9

NGC1023 LG mag 9, in Local Supercluster. ~5° S of M34 ✨

Gemini, the Twins (Chart 3, 4) The Geminid meteor shower peaks about December 14th of each year and is often the best of the year. It was first observed in 1862 with only sparse meteors. Gradually it has been getting better -- so much so that in recent years there have been as many as 100 meteors per hour. These meteors originate from the asteroid (or extinct comet) 3200 Phaethon. Phaethon is 5.1 kilometers wide and orbits the Sun every 1.4 years, shedding more dust with each pass as its surface heats up to more than 1200 °F. At some point in the very distant future, Phaethon may well collide with Earth, but we are safe for at least the next 400 years.

Beta β Pollux, K-class Hypergiant, mag 1, 40 ly. Dbl sep 3' to mag 11. A planet 3x Jupiter orbits at about the distance of Mars from the Sun.

Alpha α Castor, A-class, mag 2, 51 ly. Castor is a telescopic triple, sep 5" and 70". Spectroscopy shows it is a sextuple system of three binary pairs! Aa+Ab mag 1.93, Ba+Bb mag 2.97, Ca+Cb mag 9.83. A and B are class A. C is a class M dwarf.

Zeta ζ Mekbuda, F-class Supergiant, mag 4, 1200 ly; Cepheid var 3.6 - 4.2 in 10.15 days. 2900x the luminosity of the Sun.

Delta δ Wasat F-class Subgaint, mag 4, 59 ly. Dbl sep 5" to mag 8.

M35. Superb OC, mag 5, 300+ stars but only 15+ in binocs, 2800 ly. ~2° NW of Eta.

NGC2392 Eskimo Nebula PN, mag 10, 6500 ly. ✨

NGC2371 PN, mag 11. ~3° SSW of Castor.

NGC2129, NGC2156, NGC2304, NGC2420, NGC2266 OC's mag 7 - 11.

Auriga (Chart 3)

Alpha α Capella, G-class Giant, mag 0, 42 ly. Actually a *very* close double, the two stars orbiting each other in 104 days!

Beta β Menkalinan, A-class Subgiant, mag 2, 82 ly. Dbl sep 3' to mag 11 companion. But β Aur is itself a tight binary, orbiting in 4 days with a sep of less than 1/5 the distance between Sun and Mercury.

Epsilon F-class Supergiant, mag 3, 2037 ly. Eclipsing binary. The secondary star is surrounded by a huge disk of dust that causes 2 years of dimming. For dimming to last that long, the dust disk must extend as far out as the orbit of Uranus around the Sun. The exact cause is said to be "Astronomy's longest-running mystery show"!

Theta ϑ A-class Hypergiant, mag 3, 173 ly. Dbl sep 3.5" to mag 7 companion.

Delta δ K-class Hypergiant, mag 4, 140 ly. Dbl sep 2' from mag 10.

Omega ω A-class, mag 5, 159 ly. Dbl sep 5" to mag 8.

The Leaping Minnow. A nice group of mag 5 - 6 stars for the minnow, and a splash of surrounding fainter stars. An asterism. Center on 16 Aur, ~4° W of Iota. 16 Aur is a K-class Giant, dbl sep 4" from mag 6.

M37 OC mag 6, 11'x11', 4400 ly, ~200 stars. 450x10^6 years old.

M36 OC mag 6, 7'x7', 4100 ly, ~100 stars. 25x10^6 years old.

M38 OC mag 7, 10'x10', 3500 ly, ~100 stars. 250x10^6 years old.

NGC1907 OC mag 8, 5'x5', 4500 ly, ~30 stars, 500x10^6 years old. Near M37.

IC405 (Flaming Star Nebula) DN, mag 10, 50'x30'. ~4° W of Iota. ✨

NGC1931 OC and DN, mag 10, 5'x5'. "A miniature version of the Orion nebula." IC 410 is in the same FOV; the two together are known as "The Spider and the Fly." ✨

Taurus (Chart 3, 9) ✨

Hyades mag 1. A beautiful V-shaped cluster with the orange color of Aldeberan to pump it up! 150 ly.

Pleiades M45 mag 2, perhaps the best binocular object in the night sky. OC with nebulosity, use averted vision. 410 ly. Often called the "Seven Sisters," it is a good test of vision to try to draw the stars you actually see. I rarely get past a "little dipper" of 5 stars. ✨

Alpha *α* Aldebaran, K-class Giant, mag 1, 65 ly.

Theta2 ϑ A-class Giant, mag 3, 150 ly. Dbl sep 5.6' from **Theta1 ϑ** K-class Giant, mag 4, 154 ly. Naked-eye. ~2° W of Aldebaran.

M1 (The Crab Nebula) NB, mag 8, 8' x 4', supernova remnant of an explosion recorded by the Chinese in 1054 AD. 6500 ly. A pulsar neutron star is at its center; 30 km diameter, spins 30x/sec, the brightest persistent source of x-rays and gamma rays. ~1° **N**W of Zeta.✨

NGC1647 OC mag 6, 27'x27'-- 90+ stars, 150x10^6 years.

NGC1817 (Chart 9) OC mag 8, 9' x 9'. Right beside NGC 1807. Age ~ 10^9 years.

NGC1514 (Crystal Ball) PN mag 10, 2'x2'. Mag 9 star at its core. ~3° NW of Phi, near Perseus. ✨

Camelopardalis (Chart 3, 1) Much of the fun of this dim constellation is in its name. The camel-leopard is the name the ancient Greeks coined for the African giraffe.

Beta β G-class Supergiant, mag 4, 997 ly. Dbl sep 81" from mag 7.

NGC1502 OC, mag 7, 10'x10'. ~45 stars. "Kemble's Cascade," a nice string of stars in binocs, is in the same FOV. ~7° WNW of Beta.

NGC2403 SG, mag 8, 20'x10', 8x10^6 ly. ~20° ENE of Beta.✨

NGC1501 PN, mag 12, 1'x1'. At its center there is a close binary system whose rotation makes the visible star pulsate every half hour. ~7° W of Beta.

Ursa Major (Chart 4, 5, 1) ✨

Zeta ζ Mizar A-class, mag 2, 82 ly, dbl sep 12' from mag 4, Alcor. Separating Alcor and Mizar is a good test of unaided eyesight, but Mizar itself is a wonderful close double, separated by 14" from a mag 4 companion. The two stars, Mizar A and Mizar B, rotate around a common center in about 5000 years. In 1802 William Herschel argued that these were examples of gravitationally-bound binary stars -- the first such ever recorded. We now know that Mizar A and Mizar B are themselves very close spectroscopic binary stars. And in 2009 the techniques for finding exoplanets allowed us to determine that even Alcor is a binary star. The Universe *loves* double stars! ✨

VY (HR4195) C-class Giant, mag 6, 1300 ly. Very red. Extend a line from Kappa κ Dra through Lamda λ Dra about 5° bending slightly S**. (See Chart 1)**

M81 (Bode's Galaxy) SG mag 7, 22'x11', 12x10^{6} ly, 250x10^{9} stars. One of the densest cores known in any galaxy. Extend line from γ through α about 8°. ✨

M82 (Cigar Galaxy) IG mag 8, 11'x5', 12x10^{6} ly, 30x10^{9} stars. In the same FOV as M81, the structure of M82 has been distorted by past close interactions with its larger neighbor. Compression of its gases has caused starburst areas, rapid formation of new stars, polarized light (probably from a super-massive magnetic field), and powerful radio-band emissions. ✨

M101 (Pinwheel Galaxy) SG mag 8, 25'x25', 21x10^{6} ly, ~1000x10^{9} stars. More than 1000 H(II) regions where new stars are forming. Nearly twice as wide as the Milky Way! About 4° NNE of Alkaid. ✨

M109 SG mag 10, 8'x6', 83x10^{6} ly, ~1000x10^{9} stars. You may be able to see the central barred structure. About 1° E of Phecda. ✨

M97 (The Owl Nebula) PN mag 10, 3'x3', 2000 ly, 8000 years old. In large scopes you may see the owl face, caused by the typical bipolar radiation of a planetary nebula. At the very center is a mag 16 white dwarf that is lighting everything up -- estimated temperature, 123k °K! About 2° E of Beta. ✨

M108 SG mag 10, 4'x2', 46X10^{6} ly, 400x10^{9} stars. A supermassive black hole at its center is ~7x that of the one in the Milky Way. In the same low-power FOV as M97. ✨

NCG2841 SG mag 9, 7'x3'.

NGC3945 SG mag 10 SG. Double barred.

NGC2768 EG mag 10, 6'x2'.

NGC4036 / NGC4041 LG mag 11 and SG mag 12 in the same FOV.

NGC4088 / NGC4085 SG mag 11 and SG mag 14 in the same FOV.

NGC3613 / NGC3619 EG mag 12 and LG mag 12 in the same FOV.

NGC 3998 / NGC3982 LG Mag 12 and SG mag 12 in the same FOV.

Leo Minor (Chart 4)

NGC3486 SG mag 10, 6'x4', 34x10^{6} ly.

NGC3344 SG mag 10, 6'x6'. Face-on. 22x10^{6} ly. Site of a supernova in Oct. 2012.

NGC3294 SG mag 11, 3'x2'.

NGC3486 SG mag 11, 6'x4', 27x10^{6} ly.

NGC2859 LG mag 12, 3'x3'. 83x10^{6} ly.

NGC3504 SG mag 12, 2'x2'.

NGC3414 LG mag 12, 3'x1'. Listed as Arp 162 in the *Atlas of Peculiar Galaxies.*

NGC3277 SG mag 12, 2'x2'.

NGC3245 LG mag 12, 4'x2'.

Lynx (chart 4, 3)

38 A-class mag 4, 122 ly, dbl sep 3" to mag 6. 122 ly.

NGC2419 GC mag 9, 12x10^{9} years old. At 300k ly it is one of the most distant globs. It is closer to our satellite galaxy (the Large Magellanic Cloud) than it is to the Milky Way itself.

NGC2683 SG mag 10, 10'x3'.

NGC2782 SG mag 12, 3'x2',

Bootes (Chart 5, 11)

Alpha α Arcturus K-class Giant, mag 0, 37 ly. Third brightest star in the night sky. Relatively old at 7x10^9 years. Light from Arcturus was used to flip a switch and start the 1933 Chicago World's Fair. It is listed as a "peculiar emission" star because of its multiple spectral lines.

Eta η Muphrid G-class Hypergiant, mag 3, 40 ly. Dbl sep 2' to mag 9.

Epison ε Izar (Pulcherrima) K-class, mag 3, 300 ly. Dbl sep 2.8" to mag 5.3. Nice blue-white color contrast.

Beta β Nekkar G-class Giant, mag 4, 219 ly. It is a flare star that has random, brief spikes in luminosity.

Delta δ Princeps G-class Giant, mag 4, 117 ly, dbl sep 105" to mag 8.

Mu μ F-class Subgiant, mag 4, 121 ly, dbl sep 109" to mag 7.

Theta ϑ F-class, mag 4, 48 ly. Dbl sep 69¨ to mag 11.

Kappa κ A-class Subgiant, mag 5, 155 ly. Dbl sep 13" to mag 7. ✨

NGC5466 GC mag 10, 7'x7', 52,800 ly. **NGC5557** EG mag 12, 2'x1'. **NGC5676** SG mag 12, 4'x1'. **NGC5689** LG mag 13, 4'x1'

Canes Venatici (Chart 5)

Alpha α Cor Caroli A-class Hypergiant, mag 3, 110 ly, dbl sep 20" from mag 6. Named for the bleeding heart of beheaded King Charles I. It is a "metallic" star with unusual amounts and distributions of various metals. It also has a very strong magnetic field, producing large, long-lasting sunspots. ✨

Gamma γ La Superba C-class Supergiant, mag 5, 710 ly. C-class stars are even cooler than M-class with temperatures of less than 3000 °K. It is one of the reddest stars -- indeed much of its luminosity is actually in the infrared spectrum. Contains large amounts of C13. Var 4.8 - 6.3 in 160 days. Located about 4° NE of Beta.

M3 GC mag 6, 16'x16'; 34k ly; 500K stars; ~9x10^9 y. About 12° SE of Alpha. ✨

M94 SG, mag 8, 8'x7'; 16x10^6 ly. Beautiful face-on galaxy for astropics. About 3° NNW of Alpha. ✨

M51 Whirlpool aka **NGC5194** SG, mag 8, 14'x12'; 23x10^6 ly. Linked to **NGC5195,** a mag 11 dwarf galaxy. Famously, M51 was drawn in 1845 by Lord Rosse using the Leviathan 72" telescope. He resolved individual stars in the "nebula." This was the first real evidence that some nebulae might be "island universes" -- i.e., galaxies. About 4° WSW of Alkaid, Eta η UMa. ✨ ✨

M106 SG, mag 8, 17'x7', 24x10^6 ly. A maser galaxy (microwave amplifier by stimulated emission of radiation) that allows precise measurement of distance. It is a Seyfert II galaxy with an accretion disk gradually being eaten by a supermassive black hole. About 6° NNW of Beta. ✨

M63 Sunflower Galaxy SG, mag 9, 12'x7', 37x10^6 ly. Prototype of the flocculent spiral galaxies. About 5° NE of Alpha. ✨

NGC4631 Whale Galaxy SG, mag 9, 14'x2', 30x10^6 ly. Central starburst region along with strong x-ray emission. About 6° SSW of Alpha. ✨

Coma Berenices (Chart 5, 11) A constellation with only a sprinkling of dim stars and over 1000 deep sky objects!

Beta β F-class, mag 4, 30 ly. Dbl sep 91" to mag 10.

31 G-class Hypergiant, mag 5, 300 ly. This star is within a few arcseconds of the north galactic pole. It is also a rare FK variable, spinning rapidly with large sunspots.

M53 GC mag 8, 9'x9', 58k ly, 500k stars, 12.7x10^9 years old. Most stars in GCs are very old, but M53 contains quite a few "blue stragglers" -- short-lived, hot blue stars, perhaps formed by the merger of two old stars. About 1° NE of Alpha.

M64 (Black-Eye Galaxy) SG mag 9, 11'x5', 100x10^9 stars, 35k ly. Named for a dark dust band near the core. Has two counter-rotating disks of dust probably caused by a past encounter with a nearby galaxy. Dust compaction where the two disks cross produces starburst regions. About 5° NNW of Alpha. ✨

M100 (The Mirror of M99) SG mag 9, 6'x6', 400x10^9 stars, 55x10^6 ly. About 11° WSW of Alpha. ✨

M85 LG mag 9, 7'x5', 400x10^9 stars, 62,500 ly. In same FOV and interacting with NGC4394. The first-ever luminous red nova was observed in M85 (January 2006). Such novae are thought to be caused by two stars merging. About 3° NNE of M100. ✨

M99 (Coma Pinwheel) SG mag 10, 5'x5', 150x10^9 stars, 56x10^6 ly. (Chart 11) About 1° SE of M98.✨

M98 SG mag 10, 11'x3', 1000x10^9 stars, 44x10^6 ly. About 3° WSW of M100.✨

M91 SG mag 10, 5'x4'. About 8° WSW of Alpha.✨

M88 SG mag 10, 9'x4'. About 1° W of M91. ✨

NGC4278 EG mag 10, 3'x3', 55x10^6 ly. Probably contains a supermassive black hole of 300x10^6 M⊙!

NGC4494 EG mag 10, 4'x4', 45x10^6 ly. Hosts a supermassive black hole of about 30x10^6 M⊙.

NGC4274 SG mag 10, 4'x2', 45x10^6 ly.

NGC4559 SG mag 10, 11'x5', 30x10^6 ly. Contains the luminous blue variable (LBV) star, AT2016blu, which "blinks on" every year or so. LBVs are very rare and are among the most luminous and most massive stars known.

NGC4394 SG mag 12, 3'x3'. Large scopes may show barred structure.

NGC4565 (Needle Galaxy) SG mag 12, 17'x3'. ✨

Vulpecula (Chart 6)

Alpha α Anser M-class Giant, mag 5, 297 ly. Dbl sep 7' to mag 6.

M27, PN, The Dumbbell, mag 8, 8'x6', 1400 ly, tiny in binocs, nice in big scope, great for astro imaging. Large central white dwarf, 0.05 R⊙. ✨

HD 189733 K-class, mag 8, binary star which is orbited by a Jupiter-size planet on which water has been detected! Located only 20" from M27.

CR399 Coat Hanger, first described by Al Sufi in 964, 10 stars of mag 5 - 7. Near **NGC6802.**

1 Vul B-class Subgiant, mag 5. Dbl sep 40" from mag 12. About 1° ENE of 1 Vul you'll find PSR B1919+2, the first pulsar ever discovered. Jocelyn Bell Burnell observed it on 28 November 1967. It was such a strange thing that it became nicknamed LGM-1 (Little green men).

NGC6940 OC mag 6, 11'x11'. About 3° west of 23 Vul.

NGC6802 OC mag 9, 5'x5'.

NGC6823 / NGC6820 OC + DN mag 7, 6'x6', 6000 ly, age 2x10^{6} years. Hot, young star-creation center. Great for astro imaging! ✨

NGC6830, NGC6882 OC's mag 8.

Sagitta (Chart 6) The 3rd smallest constellation after Crux and Equuleus.

M71, loose GC, mag 9, 13k ly. Relatively young for GC, age 9x10^{9} y, hence higher metallicity 2nd or 3rd generation stars. 20k stars.

Lyra (Chart 6) ✨

Alpha α Vega A-class Hypergiant, mag 0, 5th brightest star, very nearby (25 ly), 2.3x M⊙, 2.5x D⊙, 400x10^{6} y. Vega will be the north star in 12k AD.

Double-Double Epsilon Lyrae 5th mag, dbl sep 3.5'. E1 is itself a mag 6 double with a separation of 2.6". E2 is a mag 5 close double with a separation of 2.3". The Double-Double is a classic test of the resolving power of a small scope. ✨

Delta1 δ1 & Delta2 δ2 Beautiful binoc double, blue-orange. Delta2 mag 4, red M-class, 736 ly. Delta1 mag 6, 991 ly, hot B-class. Both stars are themselves doubles in scopes: δ1 mag 6 & 10, sep 175"; δ2 mag 4 & 11, sep 88".

Beta β Sheliak, B-class Bright Giant, eclipsing var mag 3.4 - 4.3 in 12.9 days. 881 ly. Dbl sep 46" to mag 9.

Zeta ζ Lyrae, 4 mag, tight binocular double, A-class and F-class dwarf stars, sep 44".

13 Lyrae M-class Giant, var mag 3.9 - 5.0 in 46 days.

M57 Ring Nebula PN, mag 9, 1.5'x1.5', 23k ly. Its central white dwarf is a very hot (120k °C) red giant like Mira that blew up about 7000 years ago. ✨

M56 GC mag 8, 6'x6', 33k ly, 80k stars. It may have been part of a dwarf galaxy that was absorbed by the Milky Way. Its parent, Omega Centauri, is now a huge globular cluster of about 10x10^{6} stars that is prominent in the southern hemisphere. ✨

Hercules (Chart 6, 12)

Beta β Kornephoros G-class Giant, mag 3, 148 ly. Dbl sep 4' to mag 10.

Delta δ Sarin A-class Subgiant, mag 3, 78 ly. Dbl sep 9" to mag 9.

Mu μ G-class Subgiant, mag 3, 27 ly. Dbl sep 34" to mag 10.

Gamma γ A-class Giant, mag 4, 195 ly. Dbl sep 42" to mag 10.

Rho ρ B-class Giant, mag 5, 400 ly. Dbl sep 4" to mag 6.

30 Her (About 1° SW of Sigma σ) M-class Giant, mag 5. Semi-regular var. 73 - 93 days, mag 4.7 - 6, 361 ly. Mass of Sun, 230x radius, soon to go nova and then become a planetary nebula and white dwarf.

M13, Great Hercules Cluster, Best of all globs, 20'x20', mag 6, 22k ly, 300k stars, age 11.65x10^{9} y. The Arecibo radio message about humanity was sent toward M13 in 1974, but it will miss because M13 will haved moved. M13 is a likely location for one of the elusive intermediate-mass black holes, but such clusters are so dense that the center cannot be mapped. So dense is its core that stars can merge and form "blue stragglers". ✨

M92 GC mag 6, 27k ly, age 11x10^{9} y, 330k stars, compact. Very low metallicity, consistent with age. About 6° N of Pi. ✨

NGC6207 SG mag 12, 3'x2', 30x10^{9} ly. In the same FOV as M13.

NGC6229 GC mag 10, 5'x5', 100k ly.

Draco (Chart 6, 5, 1)

Gamma γ Eltanin K-class mag 2 Giant, 148 ly. Dbl sep 2' to mag 11.

Eta η Athebyne G-class mag 3 Giant. Dbl sep 9' to mag 8.

Nu ν (Chart 1) Nu1 and Nu2 are a beautiful A-class mag 5 pair. Sep 60".

M102 (Spindle Galaxy) LG mag 10, 6'x3', 50x10^{6} ly, 100x10^{9} stars. Edge-on. About 4° SW of Iota. ✨

NGC6543 (Cat's Eye) PN mag 9, 20"x20". First PN to be observed with a spectroscope by William Huggins in 1864. The bright emission lines proved it was composed of ionized gas. About 5° E of Zeta. ✨

Corona Borealis (Chart 6, 5)

Zeta ζ B-class, mag 5, dbl sep 6" to mag 6.

Cygnus (see Chart 7)

Lacerta (Chart 7) -- A very rich part of the Milky Way to scan with binocs.

2 Lac B-class mag 5, 509 ly. Dbl sep 48" to mag 11 companion.

5 Lac M-class Hypergiant mag 4, 1164 ly, irregular var.

10 Lac a rare O-class dwarf star, mag 5, 1058 ly, about 8° north of Eta Peg. Hottest, shortest-lived of stars. 0.00007% of stars fall into this class. Less than 10 million years left to live. Dbl sep 62" to mag 10 companion.

15 Lac M-class Hypergiant, mag 5, 326 ly. Dbl sep 104" to mag 11 companion.

NGC7209, NGC7295, NGC7243 OC's mag 6 - 10.

Cygnus (Chart 7, 6)

Alpha *α* Deneb A-class Supergiant, mag 1, 1425 ly, age ~400x10^6 y, 23x M⊙. Very luminous. If placed at the distance of Vega (25 ly), Deneb would be 15x brighter than Venus at its brightest and easily visible in daylight! It is 100x the diameter of the Sun. For comparison, VY Canis Majoris is up to 2,100x the diameter of the Sun (about the orbit of Saturn). Deneb will become a supernova soon (within 10^6 years) so enjoy it now!

Gamma *γ* Sadr F-class Supergiant, mag 2, 1500 ly. Dbl sep 140" to mag 11.

Beta β Albireo K-class, mag 3, 385 ly, orange/blue dbl. BetaA mag 3, BetaB mag 5, sep 35". Perhaps the prettiest double star in the sky! ✨

Delta *δ* Cygni, B-class Subgiant, mag 3, 171 ly. Dbl sep 2' to mag 6.

NGC7000, North America Nebula, mag 4, emission nebula 3° east of Deneb, 4x diameter of the Moon. Use averted vision. ✨ ✨

IC5070 (Pelican Nebula) DN (HII), mag 8, 1800 ly. Just E of NGC7000. ✨

30, 31 (Omicron), 32 Cygni, dbl for binocs but triple in scopes: one orange, two blue -- mags 4, 5, and 7. Sep 5.5' and 1.8'. About 5° WNW of Deneb.

Psi ψ O-class Giant, mag 5, 289 ly. Dbl sep 3" to mag 7. About 4° E of Iota.

61 Cygni, telescopic double, sep 29", CygA mag 5, CygB mag 6; first star with measured distance, 11.1 ly (1840). 7° NE of Epsilon ϵ Cygni.

M39 OC mag 5, 30+ stars, 800 ly. Noted by Aristotle in about 325 BC. Fairly young stars, age 200x10^6 y. About 8° ENE of Deneb.

M29 OC mag 7, 4K ly, 1/4 size of moon, 5 or 6 hot, young B-class stars. Age 10x10^6. About 2° S of Gamma γ. ✨

NGC6992, NGC6995, NGC 6960 (Veil Nebula) supernova remnants, mag 7, 3°x3°, 2400 ly. Between **ε** and ***ζ***. ✨ ✨ ✨

NGC6888 (Crescent Neb) DN mag 7, 20'x10'. About 2° SW of Gamma γ. ✨

NGC6826 PN mag 9, 25"x25" (Called the Blinking Neb.)

NGC6834 OC mag 8, 5'x5'.

NGC6910 OC mag 7, 6'x6'.

NGC6946 (Fireworks Galaxy) SG mag 10, 11'x11', near eta η Ceph. 25x10^6 ly. Gets its name from the 10 supernovae observed in it since 1917. This is 10x the rate observed in our galaxy, yet NGC6946 has only 1/2 the stars.

Cepheus (Chart 7, 1)

Alpha *α* Alderamin A-class mag 2, 48 ly. Dbl sep 3' to mag 11.

Beta β Alfirk (Chart 1) B-Class Subgiant, mag 3, 690 ly. Dbl sep 13" to mag 8. Cepheid var, mag 3.16 - 3.27 in 4.57 hours.

Eta η K-class Hypergiant, mag 3, 47 ly. Dbl sep 52" tp mag 12.

Delta *δ* F-class Supergiant, mag 4, 982 ly. Dbl sep 41" to mag 6. Prototype Cepheid variable, mag 3.6 - 4.3 in 5.37 days.

Epsilon ε F-class Hypergiant, mag 4, 84 ly. Dbl sep 2' to mag 9.

Mu μ (Herschel's Garnet Star) M-class Supergiant, mag 4, 2800 ly. One of the largest known stars (1300x D⊙) and 250k times brighter than the Sun! Irregular variable, mag 3.6 - 5.1. Will probably evolve back into a Blue Supergiant before finally going supernova.

VV Cephei M-class Supergiant, mag 5, 4900 ly. Located about 1° SW of Xi *ξ*, VV Cephei is one of the largest known stars at about 1000 R⊙ which is nearly as large as the orbit of Jupiter. It is in an eclipsing binary system with a hot B-class star on a 20-year orbit. Matter flows from M-class star to its hotter B-class companion during part of the orbit, causing some of the variability.

Omicron *o* (Chart 1) K-class Hypergiant, mag 5, 211 ly. Dbl sep 3" to mag 7.

NGC7160 OC mag 6, 4'x4'.

NGC7023 (Iris Nebula) (Chart 1) DN mag 7, 10'x8', 1300 ly. About 3° SW of Beta. ✨

NGC7380 (Wizard Nebula) OC and DN, mag 7, 25'x20', 8500 ly. OC discovered by Caroline Hershel in 1787. The nebulosity requires very dark skies and an O(III) filter. About 2° E of Delta. ✨

Sh2-155 (Cave Nebula) DN mag 8, 50'x30', 2400 ly. Visually difficult. About 4° S of Iota. ✨

NGC6939 OC mag 8, 7'x7'

NGC7062 OC mag 8, 4'x4'.

NGC7086 OC mag 8, 9'x9'.

NGC7209 OC mag 8, 24'x24'.

NGC7142 OC mag 9, 10'x10'. The reflection nebula, NGC7129, is in the same FOV. About 4° NE of Alpha.✨

NGC7128 OC mag 10, 3'x3'.

NGC40 (Bow-Tie) PN mag 11, 1'x1', 3500 ly.

Cetus (Chart 8)

There are few bright stars in Cetus because you are looking straight out of the galaxy orthogonally along the line of the South Galactic Pole. That pole is located in Sculptor about 7º SSE of Beta **β** Ceti. The North Galactic Pole is in Coma Berenices between Beta and Gamma -- a more active region of the sky because it is close to the Virgo Galaxy Cluster.)

Beta β Diphda G-class Giant, mag 2, 96 ly.

Omicron o Mira M-class Giant, var. 332 days, mag 3 - 10.2, 420 ly. Mira is moving at a fast 80 km/sec and has a long tail -- 13 ly -- only seen in the UV spectrum. It is a red giant on the way to becoming a planetary nebula and white dwarf. Dbl sep 2' to mag 10.

Gamma γ "Kaffaljidhma" A-class, mag 3, 82 ly; dbl sep 3" to mag 6. Also Gamma-C, sep 15', mag 10.

Nu ν Ceti G-class Giant, mag 5, 370 ly; dbl sep 8" to mag 10.

Zeta ζ Ceti, Chi χ Ceti, and HD 11131. Zeta (mag 4) and Chi (mag 5), sep 30'. HD 11131 (mag 7), sep 3'. HD 11131 is a G-class twin of the Sun -- 0.9 M⊙, 0.9 R⊙.

Kappa 1 K1 **Ceti** G-class, mag 5, 30 ly. About the same size as the Sun but only a few 100 million years old. Rapid rotation. Strong solar winds. Dbl sep 4' to mag 9.

NGC247 SG mag 9, 21'x6'. About 3° SSE of Beta.

M77 SG mag 9, near Delta δ Ceti, barred, 7'x6', 47x10^6 ly. Perhaps 300x10^9 stars, supermassive black hole of 15x10^6 M⊙. ✨

NGC908 SG mag 10, 6'x3', 55x10^6 ly. 5º E of Upsilon υ.

NGC1052 EG mag 10, 3'x2'. Supermassive black hole, 154x10^6 M⊙. 4º W of Eta η Eri.

NGC1055 SG mag 11, 7'x4'. Same FOV as M77. Edge-on with a dark dust lane.

NGC584 EG mag 11, 4'x3'. Note NGC596 and NGC615 in the same FOV. 3º ENE of Theta **ϑ**.

NGC936, LG mag 11, 4'x3'. 3º NE of Mira.

NGC157 SG mag 11, 4'x3'. 4º E of Iota ι.

NGC246 PN mag 11, 4'x4', "Pac-Man Nebula." 5º WSW of Eta η.

NGC1022 SG mag 11, 2.5'x2'. 6º SE of Mira.

IC1613 IG mag 10, 18'x17'. Very dim and diffuse, bordering Pisces. 12º N of Eta η.

Pisces (Chart 8, 13)

Two fish on a stringer -- hard to see. Look for the Circlet just below Pegasus. Look for a triangle near Andromeda.

Alpha α Alrescha, A-class Hypergiant, mag 4, 310 ly. Dbl, sep 4" to mag 5.

19 (Chart 13) C-class Bright Giant, mag 5, 760 ly. Very red. C-class stars are carbon stars -- cooler and redder than M-class! Also known as TX Psc. 1° E of the line from Iota ι to Lamda λ.

Kappa κ A-class Hypergiant, mag 5, 162 ly. Binoc dbl with mag 6.

M74 SG mag 9, 9'x9', grand design, 30x10^6 ly, 100x10^9 stars. Seen face-on, it is called the "Phantom Galaxy" because of its low surface brightness. Its core contains an ultraluminous x-ray source, which suggests the possibility of an elusive intermediate-mass black hole. 2º ENE of Eta η. ✨

NGC488 SG mag 10, 5'x4', 90x10^6 ly. Tightly-wound spiral arms. Almost 2x the size of the Milky Way. 2º WSW of Mu **μ.** ✨

NGC524 LG mag 11, 3'x3', 90x10^6 ly. 4º NW of Mu **μ.**

Aries (Chart 8, 2)

Gamma γ Mesarthim -- B-class, mag 5, 164 ly. Dbl sep 8" to mag 5. ✨

Lamda λ -- F-class, mag 5, Hypergiant, 133 ly. Dbl sep 37" from mag 7.

NGC772 SG mag 10, 5'x3', spiral, 130x10^6 ly. 2x the size of the Milky Way.

Eridanus (Chart 8, 9, 14, 15), The River, winds down through a huge section of sky from just northwest of Rigel down much further south than we normally observe.

Omicron-2, 40 Eri, Keid (Chart 9). K-class mag 4, 16 ly. Triple star system. Eridani B and C are 83" from A. They are very close to each other (9") and very colorful. Eridani C is a red dwarf, mag 11.2. Red dwarfs are small in mass and low in temperature, but very common in the Milky Way. Still, no red dwarf is visible to the naked eye! Eridani B is even more unusual; it is a white dwarf mag 9.5 -- the most easily seen white dwarf in the entire sky. Our Sun will become a white dwarf after it has exhausted all its hydrogen and blasted off its outer layers. One cubic inch of Eri B's matter would weigh 4 tons! [Put an elephant in a teaspoon!] Viewed with an 8" Dob at 150x, the colors – yellow for A, white for B, and pale red for C – are amazing! 40 Eridani B and C are closer together than the gap between the Sun and Neptune, and orbit each other in a 252-year cycle. They circle 40 Eridani A in about 7000 years. In 2018 an Earth-like planet was found orbiting around Eridani A in the habitable zone. It is just where *Star Trek* said we would find the home of Dr. Spock! ✨

NGC1084 SG, mag 11, 3'x2', 63x10^6 ly. 3º WNW of Eta η.

NGC1407 EG mag 10, 5'x4', 76x10^6 ly. 7º SW of Gamma γ.

Orion (Chart 9) ✨

Beta β Rigel B-class Supergiant, mag 0, 770 ly. Young star, 10x10^6 years old. Dbl sep 9" to Mag 7 Rigel BC -- itself a double. Plus at 44" there is 15th mag Rigel D.

Alpha α Betelgeuse M-class Supergiant, mag 1, 430 ly. 900x diameter of the Sun. Alpha varies irregularly both in period and magnitude. It dimmed dramatically at the end of 2019, probably because of a big burp of dust combined with a cold patch on the surface. Its central hydrogen has all burned to helium, which is now fusing. Alpha could soon go supernova and get as bright as the Moon.

Delta δ Mintaka (west belt) O-class Giant, mag 2, 916 ly. Dbl sep 52" to mag 7. Surface temp ~ 60k °K. Mintaka is apparently a spectroscopic triple with B and C components orbiting in less than 6 days. Similarly, the mag 7 companion star is a spectroscopic binary with a companion star orbiting in 30 days.

Zeta ζ Altinak (east belt) O-class Supergiant mag 2, 817 ly. Dbl sep 2.4" to mag 4. Surface temp ~ 29k °K. The famous Horsehead Nebula (Bernard 33) and Flame Nebula (NGC2024) are in the same low-power FOV as Altinak. ✨

Eta η B-class, mag 3, 900 ly. Dbl sep 1.5" to mag 5.

Lamda λ Meissa O-class Giant, mag 4, 1000 ly. Dbl sep 4" to mag 6. The Meissa Cluster is a pretty OC of 12+ stars in 4°.

Rho ρ K-class Hypergiant, mag 4, 340 ly. Dbl sep 7" to mag 8.

Sigma σ O-class mag 4, 1150 ly. A cluster of 4 stars in a ragged line. The brightest of these, AB, is a binary too close to separate in small scopes. AB is sep 11" to mag 9 C. D and E (both mag 7) are 12" and 42" on the opposite side of AB. E has a strong magnetic field and strange patches of helium in its atmosphere. ✨

Struve 761 Triple-star system about 3**'** NW of Sigma σ. The A star is 50" from BC. B is just 8" from C. Very pretty. ✨

M42/M43 The Great Orion Nebula. OC and DN, mag 4, 90'x60'. 1344 ly. Note the 4-star Trapezium at its core; Theta-1 C Orionis is mag 5, but 250kx more luminous than the Sun! -- so young and hot that electrons are stripped from the surrounding clouds of hydrogen. When these electrons are recaptured they emit light, making this an emission nebula. ✨

M78 DN (reflection) mag 8, 5'x5'. 1600 ly. 3º NE of Zeta. ✨

NGC1788 DN (reflection) mag 5.8, 2'x2'. 1300 ly. 5º NNW of Rigel.

NGC1980 (lower sword) DN mag 2.5, 9'x9' ✨

NGC2175 DN mag 7, 5'x5'. 1º E of Chi χ2 Ori.

NGC2174 (Monkey's Head) DN, H(II) mag 7, 40'x30'. Same FOV as NGC2175. ✨

NGC2169 OC mag 6, 7'x7', 3600 ly. Nicknamed the "37" cluster because the stars seem to form the numerals. 7º NNE of Betelgeuse.

NGC2186, NGC2194 OC's mag 9.

Monoceros (Chart 9) -- the Unicorn

This is not one of the original constellations listed by Ptolomy, but was added by Jakob Bartsch early in the 17th century. Monoceros contains two nearby black holes: V616 at about 3000 ly; and V723 near Beta at about 1500 ly.

Beta β B-class, mag 4, triple. A - BC sep 7". B - C sep 3". 690 ly.

Zeta ζ G-class Supergiant, mag 4, 1900 ly. Dbl sep 66" to mag 9.

Epsilon ε A-class, mag 4, 128 ly. Dbl sep 13" to mag 7.

M50 OC, mag 6, 14'x14', 3100 ly. 8º ESE of Beta. ✨

NGC2237-9, NGC2244 (Rosette Nebula) DN (emission), mag 5, 80'x60', 5500 ly. 11º N of Beta. ✨

NGC2264 Christmas Tree Cluster and Cone Nebula, OC + DN, mag 4, 11'x11'. 2600 ly. 16º NNE of Beta. ✨

NGC2215, NGC2232, NGC2236, NGC2252, NGC2253, NGC2286, NGC2301, NGC2324, NGC2335, NGC2343, NGC2506, OC's mag 4 - 9

Lepus, the Hare (Chart 9, 15) ✨

Beta β Nihal, G-class Bright Giant, mag 3. Dbl sep 2.6" to mag 7.

Gamma γ, F-class, mag 4. Dbl sep 97" to mag 6.

R (Hind's Crimson Star) C-class Giant, var mag 5-12 , 1400 ly. About 4° WNW of Mu μ.

M79 GC mag 9, 7'x7'. 150k stars, mostly red giants. Age 11.7x10^9. Rare extragalactic GC believed to have migrated into the Milky Way from the Canis Major Dwarf Galaxy. About 4° SSW of Beta.

NGC1964 SG, mag 11, 6'x2'.

Canis Minor (Chart 9)

Alpha α Procyon, F-class Subgiant, mag 0.4, 11 ly. Dbl sep 5' to mag 11 white dwarf. Procyon B was first observed in 1896 by John Martin Shaeberle using the 36" Lick refractor. Few observers -- even with 32" refractors -- have been able to separate the stars!

Cancer (Chart 10, 4)

Iota ι G-class Giant, mag 4, 300 ly. Dbl sep 30” to mag 7.

M44 Praesepe, The Beehive. OC, mag 4, 577 ly. Contains about 1000 stars, 2/3 Red Dwarfs. In 1609 Galileo turned his novel telescope to Praesepe and realized that it was not just an area of nebulosity as had been thought previously. He wrote of it: “The nebula called Praesepe contains not one star only but a mass of more than 40 small stars.” M44 is somewhat unique among open clusters in that its stars are particularly young. It includes both white dwarfs and red giants. The estimated age of M44 is about 600 million years. The common name, the beehive, suggests its appearance. But another, more entertaining, name for its appearance comes from the ancient Chinese. They called it "the exhalation of piled-up corpses"-- perhaps from all the flies buzzing around in such areas.

M67 OC mag 7, 100 stars, 30’x30’. 2700 ly. 4x10^9 years old! ✨

Leo (Chart 10, 4) ✨

Alpha α Regulus B-class, mag 1, 77 ly. Rotates in 16 hours, making it oblate. Its equatorial diameter is 1/3 longer than its axis. Dbl sep 3’ to mag 8.

Beta β Denebola A-class, mag 2, 36 ly. Dbl sep 4’ to mag 9. Denebola is also a lovely binocular double with a mag 5 star to the south about 1/2º**.**

Delta δ Zosma A-class, mag 3, 58 ly. Dbl sep 3’ to mag 9.

Gamma γ Algieba K-class Giant, mag 3, 126 ly. Dbl sep 5” to mag 4. ✨

Zeta ζ Adharfera F-class Hypergiant, mag 3. Dbl sep 5’ to mag 6.

M65 SG mag 9, 35x10^6 ly, 8’x2’. 200x10^9 stars. 35x10^6 ly. M65 contains very little stellar dust and is forming few new stars. M65, M66, and NGC3628 are in the same FOV. 3º SSE of Theta **ϑ**. ✨

M66 SG mag 9, 36x10^6 ly, 9’x4’. 200x10^9 stars. 36x10^6 ly.

M96 SG mag 9, 31x10^6 ly, 8’x5’. 100x10^9 stars. 31x10^6 ly. Same FOV as M95. 9º E of Regulus. ✨

M95 SG mag 10, 33x10^6 ly, 3’x3’. 40x10^9 stars. 33x10^6 ly. M95 has a lovely star-burst ring around its core where new stars are forming. Supernova in 2012 peaked at mag 13. ✨

M105 EG mag 10, 32x10^6 ly, 5’x5’. 40x10^9 stars. 32x10^6 ly. NGC3384 is in the same FOV. ~2º NE of M95. ✨

NGC3521 SG mag 9, 8’x5’.

NGC2903 SG mag 9, 12’x5’. ✨

NGC3628 SG mag 9, 11’x3’.

NGC3489 LG mag 10, 3’x2’.

NGC3377 EG mag 10, 4’x2’.

NGC3640 EG mag 10, 4’x4’.

NGC3412 LG mag 11, 4’x2’.

NGC3384 EG mag 11, 6’x3’.

NGC3193 EG mag 11, 2’x2’.

NGC3190 SG mag 11, 4’x2’. 60x10^6 ly. 2 supernovas in 2002. In the same FOV as NGC3193, NGC 3185, and NGC3187. ✨

NGC3705 SG mag 11, 4’x2’.

NGC3626 LG mag 11, 3’x2’.

NGC3810 SG mag 11, 3’x2’.

NGC3593 LG mag 12, 5’x2’.

NGC3227 SG mag 12, 4’x2’. Interacting with NGC3226.

NGC3226 EG mag 12, 3’x2’. 1º E of Gamma **γ**. ✨

Sextans (Chart 10)

NCG3115 Spindle Galaxy, EG mag 11, 7’x3’

NGC3166 LG mag 11, 5’x3’. Same FOV as NGC3169

NGC3169 SG mag 12, 4’x3’.

NGC2974 EG mag 12, 3’x2’.

Hydra (Chart 10, 17), the largest constellation.

Alpha α Alphard K-class Giant, mag 2, 177 ly. A barium star (containing heavy elements), formed by siphoning material from a companion that is now a white dwarf.

Upsilon υ (HR41163) C-class Giant, mag 5, 528 ly. One of the reddest of stars. 4º NW of Nu **ν**. ✨

M48 OC mag 6, 1500 ly, >50 stars, ~300x10^6 years old. ~18º W of Alpha.

M83 (Chart 17) Southern Pinwheel, SG mag 8, 14’x13’. 15x10^6 ly. M83 has a high rate of new star formation and also a high rate of supernovae production. It also has a double core (like M31) -- perhaps evidence of a past merger with a smaller galaxy. 8º SE of Gamma. ✨

NGC3621 (Chart 17) SG mag 10, 10’x4’. 3º SW of Xi ξ.

Virgo (Chart 11, 11a), the 2nd largest constellation.

Alpha ⍺ Spica B-class Giant, mag 1, 262 ly. Hipparchus discovered the precession of the equinoxes in 127 BC by noting the change in position at equinoxes of Spica and Regulus compared to data from 150 years earlier.

Gamma 𝜸 Porrima F-class Hypergiant, mag 4, 39 ly. Dbl sep 3” to mag 4.

The Virgo cluster (extending into Coma Berenices) contains about 2000 galaxies averaging 65x10^{6} ly away. Here are some of them--

M87 EG mag 9, 3’x3’, 53x10^{6} ly. Most massive known galaxy. While the Milky Way has 580x10^{9} M⊙, M87 has 2400x10^{9} M⊙ -- with the largest known supermassive black hole at its center. A huge jet of energetic particles (electrons and radio frequency light) radiates out from the black hole at the speed of light, but because of observational mechanics, the material looks like it's moving *faster* than the speed of light! If the galaxy were the size of a grain of sand, then the radio jets extending out of it would spread across the width of your hand. While the Milky Way has 200 - 300 globular clusters, M87 has 12k. M87 is in the gravitational center of the Virgo supercluster of 1300 galaxies which includes the 20+ galaxies of the Local Group, which in turn includes the Andromeda Galaxy and our Milky Way. M87 began as a big glob of density fluctuations at the time of the Big Bang, hence becoming an elliptical galaxy. Because it was the biggest, baddest boy around, it sank to the center of its group of galaxies and continues to accrete and absorb other galaxies making it ever bigger. Brady Haran summarizes it thus, “By luck it was fated to be a leader, and then it started showing leadership qualities.” (All info from Becky Smethurst via *YouTube*.) ~7º WNW of Epsilon **ε.** ✨

M104 SG mag 8, 8’x5’. Named the Sombrero Galaxy due to its dark dust lane. 100x10^{9} stars, 29X10^{6} ly. Large red-shift. Like 87, it has a huge central black hole and a halo of over 1000 globular clusters. 13º W of Spica, near Corvus. ✨

M49 EG mag 8, 4’x3’. Supernova SN1969Q reached mag 13. 8º WSW of Epsilon **ε.** ✨

NGC4535 SG mag 11. 8’x7’. The Lost Galaxy. Face-on. 7º WSW of Epsilon **ε.**

M58 SG mag 10, 2’x2’. 6º WSW of Epsilon **ε.** ✨

M59 EG mag 10, 5’x3’. 5º WSW of Epsilon **ε.**

M60 EG mag 9, 7’x5’. Same 1° FOV as NGC4647 and M59. 4º WSW of Epsilon **ε.** ✨

NGC4825 EG mag 9, 3’x2’.

M86 EG mag 9, 12’x8’. Same 1° FOV as M84. Blue-shifted, so moving towards us. 8º WNW of Epsilon **ε.** ✨

M84 EG mag 10, 7’x6’. Same 1° FOV as M86.

NGC4435 & NGC4438 LG mag 11 & SG mag 10. The Eyes. Same 1° FOV as M84 and M86. All are in Markarian's Chain. ✨

NGC4216 SG mag 10, 8’x2’. The Silver Streak. 11º WNW of Epsilon **ε.**✨

M90 SG mag 10, 9’x4’. ✨

M61 SG mag 10, 7’x7’. Face-on spiral. Starburst. Seven supernovas since 1926. 8º WNW of Delta 𝜹. ✨

M58 SG mag 10, 5’x4’. 62x10^{6} ly, the most distant Messier object. ~6º WNW of Epsilon **ε.**

M89 EG mag 10, 8’x8’. Almost perfectly spherical. ~6º WNW of Epsilon **ε.** ✨

NGC4753 LG mag 10, 6’x3’.

NGC5634 GC mag 10, 5’x5’. 82x10^3 ly. Extragalactic cluster, once part of Sag Dwarf Galaxy. ~3º W of Mu **µ.**

NGC4567 & NGC4568 SG mag 11 & SG mag 11. Interacting, very close! 4’x2’ & 3’x2’. 1º SSW of M58. ✨

NGC4762 LG mag 11, 8’x2’. Edge-on. Same 1° FOV as NGC4754.

NGC4429 LG mag 11, 6’x3’. **NGC4856** LG mag 11, 4’x2’.

NGC4687 EG mag 11, 7’x4’. **NGC4699** SG mag 11, 4’x3’.

NGC5054 SG mag 11, 5’x3’.

NGC5566 SG mag 11, 5’x2’. Same 1° FOV as NGC 5576.

NGC5363 LG mag 11, 4’x3’. Same 1° FOV as NGC5364.

NGC5576 EG mag 11, 3’x2’. **NGC4754** LG mag 12, 5’x2’.

NGC4536 SG mag 11, 7’x3’. **NGC4781** SG mag 12, 4’x2’.

3C 273 (not on the chart) is a mag 13 quasar, one of the few visible in a small scope. At 2.5x10^{9} ly it is one of the furthest objects visible in small scopes. It is located about halfway along the line from Porrima to 16 Virginis. Find more info at -- https://skyandtelescope.org/observing/12-quasars-for-spring-evenings/

Corvus (Chart 11)

Delta 𝜹 Algorab B-class, mag 3. Dbl sep 24” from mag 8.

NGC4361 PN mag 10, 1’x1’.

NGC4027 SG mag 11, 4’x3’.

NGC4038/4039 SG mag 11, 5’x4’. Antennae galaxies. A stream of stars from collision can be seen in astropics.✨

Serpens Caput (Chart 11, 12)

Delta 𝜹 F-class Hypergiant, mag 4. Dbl sep 4” to mag 5.

M5 GC mag 7, 23’x23’, 25k ly, >100k stars. ✨

Seyfert’s Sextet mag 13, 2’x1’, about 2° E of rho ***ρ***. ✨

Hercules (see Chart 6)

Alpha α Rasalgethi M-class Supergiant, mag 3.5. Dbl sep 5” to mag 6. Rasalgethi is usually drawn as part of Ophiuchus.✨

Ophiuchus (Chart 12, 18) ✨

Alpha α Rasalhague A-class Giant, mag 2, 47 ly.

Delta δ Yed Prior M-class Supergiant, mag 3, 170 ly. Dbl sep 65” to mag 13.

Rho ρ Multiple star system with nebulosity, mag 4. Near Scorpius. ✨

Barnard’s Star is due E of Beta Oph and very slightly NW of 66 Oph. Only 6 ly from Earth, it is a mag 9 red dwarf. It is a little larger than Jupiter but 100x denser. It rips across the sky at 10” per year, much more quickly than any other star.

M10 GC, mag 5, 8’x8’, 14k ly. 100k stars. 11.4x10^9 years old. Young for a GC. 8º NE of Zeta ζ. ✨

M12 GC, mag 6, 9’x9’, 16k ly. 200k stars. 12.7x10^9 years old. Contains relatively few low-mass stars (and hence few red dwarfs). Presumably the low-mass stars were stripped from the cluster during an encounter with a much denser part of the Milky Way. Up to 10^6 stars were thus pulled out of the cluster and into the halo of the Milky Way. 8º NNE of Zeta ζ.

M14 GC, mag 6, 3’x3’, 30k ly. 150k stars. 13x10^9 years old. 7º SSE of Beta β. ✨

M19 (see **Chart 18**) GC, mag 7, 7’x7’, 29k ly, 12x10^9 y, 300k stars. Oblate shape. 7º E of Antares ✨

M62 (see **Chart 18)** about 8º SE of Antares. GC, mag 7, 8’x8’, 12x10^9 y, 150k stars, 22k ly. Tidally distorted by passage through galactic bulge.

M9 GC, mag 8, 9’x9’, 26k ly.3º SE of Eta η. ✨

M107 GC, mag 8, 8’x8’. 100k stars, 21k ly, 14x10^9 y (one of the very oldest!) 3º SSW of Zeta ζ.✨

NGC6633 OC, mag 5, 12’x12’, 30+ stars.

NGC6235 GC, mag 7, 4’x4’. **NGC6287** GC, mag 7, 7’x7’.

NGC6356 GC, mag 7, 5’x5’. **NGC6342** GC, mag 10, 7’x7’.

NGC6287 GC, mag 10, 5’x5’. **NGC6517** GC, mag 11, 5’x5’.

NGC6369 PN, mag 11, 1’x1’, “Little Ghost Nebula”.

Aquila (Chart 12)

Alpha α Altair A-class, mag 1, 17 ly, rotates in 9 hours at nearly 3/4 of break-up speed. Moving rapidly with respect to our Sun, it travels about 1º in 5000 years.

Gamma γ Tarazed K-class Bright Giant, nearly 3000x more luminous than Sun and 55x $D_\odot$. Only 100x10^6 y but already burning helium to carbon in its core.

Epsilon ε K-class Giant. A barium star (containing heavy elements) formed by siphoning material from a companion that is now a white dwarf.

Eta η F-class Supergiant, var, mag 4.1 - 5.3 every 7.2 days.

Beta β G-class Subgiant, mag 4, dbl sep 13” to mag 12. 45 ly.

Zeta ζ A-class Hypergiant, mag 3, dbl sep 6” to mag 12. 83 ly.

Rho ρ A-class, mag 5, 154 ly. Its high proper motion caused it to cross the border into Delphinus in 1992!

V (HR7220) C-class Giant, mag 7, 1200 ly. Very red. 1º SW of Lamda **λ**.

NGC6781 PN, mag 11, 2’x2’. A dimmer version of the Ring Nebula. ✨

NGC6755, NGC6756 OC’s mags 8 and 11.

Scutum (Chart 12)

Delta δ F-class Giant, mag 5 irregular variable. 33x the luminosity of the Sun but only 2x the size. Metal-rich and pulsing in mag by ~20%. Triple sep 15” to mag 12 and 52” to mag 9.

R Scuti, a red variable between M11 and Beta. Mag 4 - 8 in 142 days.

M11 (Wild Duck Cluster) OC mag 6, 6200 ly, ~2900 stars in a V-shape, 220x 10^6 y. ✨

M26 OC mag 8, 5000 ly, ~100 stars, 90x10^6 y. Large scope may show a dark nebula in the middle.

NGC6712 GC, mag 8.

UY ScutiM-class supergiant, mag 9, ~1700 $D_\odot$. Probably the largest star that can be seen with a small scope, located about 1º N of Gamma γ.

Pegasus (Chart 13, 7)

Epsilon ε Enif K-class Supergiant, mag 2, 670 ly, 150X D$_{\odot}$. In 1972 Enif flared to 5x its normal brightness for about 10 minutes.

Beta β Sheat (**Chart 7)** M-class Giant, mag 2, 200 ly. Dbl sep 4' to mag 9.

Eta η Matar (Chart 7) G-class Bright Giant, mag 3, 215 ly. Those with sharp eyes should see mag 5 Omicron just to the south. In binocs or a small scope, this becomes a four-star system. Eta is 90" from a mag 8 companion.

51 Pegasi G-class, mag 5, 51 ly. Located 4º S of Lamda Peg. Important because it is a sunlike G-class star with a "half-size Jupiter" orbiting less than 13% of Mercury's distance from the Sun, with a period of 4.23 days! It was the first extrasolar planet discovered around a main-sequence star (1995). In 2017 traces of water were found in the planet's atmosphere.

M15 (Great Pegasus Cluster) GC, mag 6, 11'x11', 100k stars, 34x10^6 ly, 12x10^9 years old. Contains a planetary nebula and 9 pulsars. Perhaps the oldest and most dense of all Milky Way GC's. Very likely experienced a core collapse in formation of a central black hole. Also contains a double neutron star. 4° NW of Epsilon **ε**. ✨

NGC7331 (Chart 7) SG, mag 10, 11'x4'. "Stephan's Quintet" is SSW in the same FOV. Use 8" or larger scope at about 100x. Four of the galaxies are gravitationally interacting. 4° NNW of Eta **η**. ✨

NGC7217 (Chart 7) SG, mag 10, 5'x4'. 7° WNW of Eta **η**.

NGC7479 SG, mag 11, 4'x3'. Beautiful barred spiral. 3° S of Alpha **α**. ✨

NGC7814 SG, mag 12, 4'x2'. Edge-on mini Sombrero. 3° WNW of Gamma **γ.** ✨

NGC7448 SG, mag 12, 2'x1'. Just NW of Alpha **α.**

Delphinus (Chart 13)

Alpha α Sualocin B-class Subgiant, mag 4, 254 ly, dbl sep 43" to mag 11.

NGC7006 GC, mag 10, 4'x4', 137k ly.

NGC6934 GC, mag 10, 5'x5', 50k ly.

NGC6905 (**Blue Flash Nebula)** PN, mag 11, 1'x1', 6000 ly. ✨

Aquarius (Chart 13)

Beta β Sadalsuud G-class Hypergiant, mag 3, 612 ly. Dbl sep 36" to mag 11.

Alpha α Sadalmelik G-class Supergiant, mag 3, 760 ly. Dbl sep 2' to mag 12.

M2 GC mag 6, 8'x8', 33k ly, 150k stars, 13x10^9 years old. About 4° N of Beta β.

NGC7293 (Helix Nebula) PN mag 7, 12'x10', 522 ly. The largest PN in our sky but low surface brightness makes it difficult. Use low power and wide FOV. About 7° SW of Delta δ. ✨

NGC7009 (Saturn Nebula) PN mag 8, 30"x25", 3k ly. Described as an "egg-shape blob with fuzzy edges." 4° SE of Mu **μ**. ✨

M72 GC, mag 9, 10'x9', 55k ly, 100k stars, 9x10^9 years old. 4° S of Mu **μ**.

M73 (Messier's Mistake) 4-star asterism, mag 9. 4° SSE of Mu **μ**.

NGC7723 SG, mag 11, 3'x2'.

NGC7727 SG, mag 11, 4'x3.

Capricornus (Chart 13, 19)

Beta β Dabih F-class, mag 3, 344 ly. Pretty binoc dbl, sep ~3' from mag 6, Beta2. The pair orbit one another in about 700k years.

Alpha1 / Alpha2 Naked-eye dbl, 870 ly, each mag 4, sep 6'. In a scope Alpha1 (G-class) has 3 companions within 1' but mag 10 or less. Alpha2 (G-class) is a triple. The B and C components are about 7" from the primary, mag 8 or dimmer.

Nu ν Alshat B-class, mag 5, 270 ly. Dbl, sep 54" to mag 12.

Rho ρ F-class, mag 5, 100 ly. Dbl, sep 4' to mag 6.

M30 GC, mag 8, 27k ly, 12.9x10^9 years old, ~150k stars. May have been captured during past galactic interactions since it orbits in retrograde to the rest of the Milky Way. 4° ESE of Zeta ζ. ✨

Canis Major (Chart 15, 9)

Alpha *α* Sirius (See Chart 9) A-class, mag -1.5, 8.7 ly. Dbl sep 11” to mag 9. Because of the difference in magnitude, few will ever be able to split Sirius from its white dwarf companion. This was first done in 1862 by Clark using an 18” reflector at Northwestern University. Sirius B packs the mass of the Sun into a star only twice the size of Earth! Perhaps 120x10^6 years ago Sirius B had 5x $M_\odot$, but then it passed through the red giant phase, blew off most of that mass, and collapsed into the white dwarf we see today! Sirius is the 5th closest star to the Sun.

Eta η Aludra B-class Supergiant, mag 2.5, 3200 ly. Dbl sep 3’ to mag 7. If Eta were moved to the distance of Sirius, it would be as bright as the half Moon!

Zeta ζ Furud B-class, mag 3, 340 ly. Dbl sep 3’ to mag 8.

Pi *π* F-class Giant, mag 5, 95 ly. Dbl sep 12” to mag 10. Pi Cma, 15 CMa, and 17 Cma are all mag 5 and all within about 1 degree, making an attractive binocular triple.

M41 OC mag 5, 38’x38’, 2300 ly, 220x10^6 years old, 100 stars.

NGC2362 OC mag 4, 7’x7’, 5000 ly.

NGC2204 OC mag 9, 6’x6’.

VY CMa. Located about 1° SE of NGC2362, VY CMa is sometimes listed as the largest star known. It is a mag 8 Hypergiant about 4900 ly from Earth and has a radius about 1,800 times that of our Sun!

Sh2-308 DN, mag 7, 35’x35’, 4500 ly. Sharpless 308 is commonly known as the Dolphin Nebula or the Cosmic Bubble. It is a reflection nebula from hydrogen gas surrounding the Wolf-Rayet star, EZ CMa. It is located about 8° S of Sirius. Great for astropics. ✨

NGC2359 (Thor’s Helmet) (Chart 9) DN mag 11, H(II) emission, 10’x5’. 8° ENE of Sirius.✨

Sagittarius (Chart 18, 12)

Beta1 β1 Arkab Prior B-class, mag 4, dbl sep 28” to mag 7. 378 ly. (Near Corona Australis)

Gamma1 γ1 F-class Supergiant, mag 5, Cepheid var mag 5 - 6 in 8 days. ~2000 ly.

3 Sgr (about 7º NW of Gamma γ Sgr). This is very close to the center of the Milky Way and the black hole of Sgr A*. “For every billion photons emitted by a star near the center of the galaxy, on average one of them makes it as far as Earth. The other billion - 1 photons are absorbed by the intervening dust clouds.”

M8 (Lagoon Nebula) DN mag 5, 90’x40’, 4100 ly. 4º SW of Mu μ. ✨

M22 GC, mag 5, 30’x30’, 83k stars, age 12x10^9 y, dist 10,600 ly (only M4 is closer). Contains 2 black holes, perhaps more. Contains a PN. 3º NE of Lamda λ.

M24 (Chart 12) OC mag 5, 90’x90’, >1k stars, age 220x10^6 y, 10k ly. The Small Sagittarius Star Cloud is actually a break in the dark dust clouds at the heart of the galaxy. “A virtual carpet of stellar jewels” more than 1k stars are visible in binocular FOV. (Between Mu μ Sgr and M18).

M25 OC, mag 5, 30’x30’, 600 stars, 2k ly, 90x10^6 y. 4º ENE of Mu μ.

M20 (**Trifid Nebula)** PN, mag 6, 30’x30’, dist 5,200 ly, age >300k y. Emission, reflection, and dark. Plus OC. 3º SW of Mu μ.✨

M17 (Swan Nebula or Omega Nebula) (see Chart 12) OC and DN, mag 6, 10’x10’, ~5000 ly. 5º NNE of Mu μ. ✨

M21 OC, mag 7, 13’x13’, ~35 stars, age 5x10^6 y. 3º SW of Mu μ. ✨

M23 OC, mag 7, 30’x30’, 175 stars, 2150 ly, 220x10^6 y. 5º WNW of Mu μ.

M55 GC, mag 7, 20’x20’, 100k stars, 18k ly, 12x10^9 y. 5º ESE Zeta ***ζ***.

M54 GC, mag 8, 12’x12’, >1x10^6 stars, 87k ly, 13x10^9 y. The first discovered extragalactic globular cluster (1994). Probably belonged to the Sagittarius Dwarf Elliptical Galaxy, which will itself eventually be swallowed whole by the Milky Way. 1º WSW of Zeta ***ζ***.

M18 OC, mag 8, 9’x9’, ~20 stars, 5k ly, 32x10^6 y. 4º NNE of Mu μ.

M28 GC, mag 8, 11’x11’, >50k stars, 18k ly, 12x10^9 y. 1º WSW of Lamda λ.

M69 GC, mag 8, 10’x10’, 125k stars, 30k ly, 13x10^9 y. It must have formed when the universe was very young, but M69 is somehow still “metal rich.” Puzzling. 3º NW of Epsilon **ε.**

NGC6520 OC, mag 8, 5’x5’. Interesting especially because of the adjacent “ink spot”, a dark nebula named Barnard 86. ~2º N of Gamma1 **γ1.** ✨

NGC6822 (Barnard’s Galaxy) IG, mag 9, 15’x15’, 1.6x10^6 ly. One of the closest galaxies to Earth, NGC6822 is especially important in the history of astronomy because Edwin Hubble discovered 11 Cepheid variables within it. That, along with similar work on M32, proved that some nebulae were actually separate galaxies far outside the boundaries of the Milky Way. 10º ENE of Pi ***π***. ✨

M70 GC, mag 9, 8’x8’, 29k ly, 13x10^9 y. It has a compact center, having undergone “core collapse.” It was being studied separately by Alan Hale and Thomas Bopp in 1995 when they discovered their famous comet. Halfway between Zeta ζ and Epsilon ε.

M75 GC, mag 9, 3'x3', 67k ly, 400k stars, 13x10^9 y. One of the most distant globs. Near Capricornus. 14º ENE of Tau τ.

Scorpius (Chart 18)

Alpha *α* Antares M-class Supergiant, mag 1, dbl sep 3” from mag 5. 500 ly. Very difficult to split.

M7 OC, mag 3, ~80 stars, 80’x80’, ~1000 ly, 220x10^6 years old. First recorded by Ptolemy in his *Almagest* (AD 150). 4º ENE of Lamda λ.

M6 (the Butterfly Cluster), OC, mag 4, 25’x25’, ~80 stars, 1600 ly. 100x10^6 years old, but contains one K-class orange Giant, probably formed by the merger of two young, hot stars. It is the brightest star in the cluster. M6 was given its popular name by Robert Burnham in his famous *Celestial Handbook* (3 vols.). 5º NNE of Lamda λ.

M4 GC, mag 6, 30’x30’, 7200 ly, 12x10^9 years old, ~20k stars. Closest globular cluster to Earth. 1º WSW of Antares.

M80 GC, mag 8, 10’x10’, 200k stars. 12.5x10^9 years old. Contains 19 x-ray sources at its center. Two of these are low-mass x-ray binaries. X-rays like these are emitted from black holes or neutron stars. 5º NW of Antares.

NGC6231 OC, mag 3, 14’x14’, ~3x10^6 years old, ~6000 ly. About 1º N of Zeta ***ζ***.

NGC6124 OC, mag 5, 14’x14’, ~100 stars, ~18,600 ly.

NGC6302 (The Butterfly Nebula or Bug Nebula) PN, mag 9. The mag 10 white dwarf at its center is one of the hottest stars known, >250k °K. Its bipolar outflow includes calcites like dolomite and other carbonates! 4º W of Lamda λ.✨